UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

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In Re: Methyl Tertiary Butyl Ether ("MTBE") Products Liability Litigation	Master File No. 1:00-1898 MDL 1358 (SAS) M21-88
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This document relates to the following case:

City of New York v. Amerada Hess Corp., et al.
Case No. 04 Civ. 3417

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PLAINTIFF CITY OF NEW YORK'S MEMORANDUM OF LAW IN OPPOSITION TO DEFENDANTS' JOINT MOTION AND MOTION *IN LIMINE* TO EXCLUDE THE OPINION OF PLAINTIFF'S EXPERT HARRY T. LAWLESS

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INTRODUCTION

The Court should deny Defendants' motion to exclude the testimony of the City's taste-and-odor expert, Harry T. Lawless, Ph.D. Defendants are trying to capitalize on the mistakes of their adversaries in a different case involving a different expert. This is not the *Suffolk* case, and Dr. Lawless is not William Cain. Although, like Dr. Cain, the starting point for Dr. Lawless' analysis is the so-called Stocking Study, which ***both*** sides' experts agree is the most trustworthy MTBE odor study to date, Dr. Lawless has followed a vastly different path to his conclusions.

Dr. Lawless' opinion that 10% of the population can detect MTBE in drinking water at 1-2 parts per billion (ppb) is reliable and admissible under Rule 702. Not only has the "chance-corrected percentile" statistical method he employed been tested and approved in peer-reviewed publications relating to sensory testing methods generally, but statistical methods very similar to the ones Dr. Lawless used here (logistic regression plus correction for guessing) were used to analyze the same Stocking data he relied on in a 2001 peer-reviewed EPA report ***and*** a 2000 report by the Stocking co-authors themselves – including Irwin "Mel" Suffet, *Defendant's own taste & odor expert*. Like Dr. Lawless, both the EPA (2001) and Stocking et al. (2000) reports estimate the concentrations at which subthreshold percentiles of the population can detect MTBE in water – with results that indisputably corroborate Dr. Lawless' conclusions.[1] In fact, in a declaration the City submits herewith, Dr. Andrew Schulman, the EPA statistician who authored the agency's analysis of the Stocking data, provides this endorsement of Dr. Lawless' work:

> In my opinion, the assertion in the Defendants' Joint Motion that Dr. Lawless' analysis "suffers fatally from a methodology problem" is unjustified and incorrect. Statistical methods other than those prescribed by ASTM method E-679 may legitimately be used to analyze the data from the Stocking study, and the particular methods employed by Dr. Lawless in the Expert Report are appropriate

[1] *See* Appendix A for a chart comparing Dr. Lawless' methods and results with those in the EPA (2001), Stocking et al. (2000) and published Stocking et al. (2001) reports.

and scientifically valid.

(Declaration of Andrew E. Schulman, Ph.D. ("Schulman Decl.") ¶ 7.) As Defendants fail to cite a single legal or scientific basis for finding that Dr. Lawless' methods are unreliable, other than their demonstrably false allegation that his approach is "unprecedented" and their myopic interpretation of ASTM E679, their *Daubert* motion must fail.

Defendants' alternative argument, that Dr. Lawless' testimony will not assist the jury because "rejection," not "detection," is the relevant issue, reflects a serious misunderstanding of the legal and factual context in which the taste-and-odor issue arises in this case. As this Court previously held, "the jury must consider the variation in the population's ability to ***detect*** MTBE when determining the extent to which plaintiffs have been harmed," and such determination will "depend[] on the particular circumstances of the case." *In re MTBE*, 593 F.Supp.2d 549, 552 (S.D.N.Y. 2008) (the "*Cain Opinion*") (emphasis added). Dr. Lawless' testimony regarding the concentrations at which various percentages of the population can detect MTBE is exactly the kind of "scientific, technical or other specialized knowledge that will assist" the jury in that task.

And his testimony "fits" particularly well with the particular circumstances of this case because, when it comes to the factors affecting public acceptance of water in New York City, no practical difference exists between detection and rejection. As the Director of Water Quality for the City's Department of Environmental Protection ("NYCDEP") explains: (1) "residents typically find any indication that a contaminant is present in drinking water objectionable;" (2) because the groundwater system has been offline since 2007, "it is unlikely that resident who receive groundwater in the future will simply accept a new taste or odor in their water supply;" and (3) "once it is reported that certain members of the public are able to taste or smell MTBE in their drinking water, the NYCDEP will likely be faced with vocal opposition from the

community, particularly in light of the fact that the majority of the water users served by NYCDEP do not receive water with MTBE contamination." (Declaration of Steven C. Schindler ("Schindler Decl.") ¶¶ 17, 16, 9.) "Based on Dr. Lawless' conclusions, NYCDEP must treat for MTBE to achieve concentrations below 1-2 ppb in order to ensure public acceptance of the long-term use of the groundwater supply." (*Id*. ¶ 19.) On this record, Dr. Lawless' testimony is unquestionably relevant to plaintiff's claimed injuries related to MTBE levels below the MCL.

BACKGROUND

I. DR. LAWLESS' QUALIFICATIONS

Harry T. Lawless, Ph.D., is a Professor in the Food Science Department of Cornell University, where he specializes in teaching sensory evaluation methods and performing research on the chemical senses of taste and smell. (Declaration of Harry T. Lawless ("Lawless Decl.") ¶ 1.) Dr. Lawless has worked as a scientist in the field of sensory evaluation for more than 30 years since earning his doctorate in Experimental Psychology from Brown University in 1978.[2]

Today he is one of the foremost scholars in his field: he has published more than 100 articles in the peer-reviewed literature and written more than 150 additional works on topics related to chemosensory perception and testing methods. (Exp. Rept. (Defs' Ex. B) ¶ 4.) Dr. Lawless is the co-author of *Sensory Evaluation of Food: Principles and Practices*, a widely-adopted textbook designed for undergraduate and graduate courses in sensory evaluation methodology and as a reference for industrial practitioners, with a particular focus on statistics used in sensory evaluation. (*Id*.) Dr. Lawless has served as a testifying expert in litigation only five times prior to his work in this case. (Lawless Decl. ¶ 3.) He has not testified or consulted in any litigation involving MTBE prior to his engagement in this case. (*Id*.)

[2] *See* Curriculum Vitae of Harry T. Lawless at 1. Dr. Lawless' C.V. is appended to his Expert Report, which attached as Exhibit B to Defendants' motion.

II. DR. LAWLESS' OPINIONS AND METHODOLOGY

In his Expert Report, Dr. Lawless articulates his primary opinion in this case as follows:

> Based on the best study of odor detection of MTBE …, it is my opinion that MTBE can be detected by a significant portion of the population by smell in drinking water at levels of 1-2 parts per billion (ppb). Based on the best study of odor detection of MTBE to date, this proportion is approximately 10%.

(Exp. Rept. (Defs' Ex. B) ¶ 6). Dr. Lawless also concludes, based on the same study, that 25% of the population can detect MTBE at 3 ppb and 50% of the population at 14 ppb. (*Id.* ¶ 16.)

The study on which Dr. Lawless relies is the so-called "Stocking Study" – the MTBE odor study involving 57 untrained consumer panelists carried out by the National Food Laboratory in 1998, and later described in a published report by Andrew Stocking, Mel Suffet and others.[3] (Lawless Decl. ¶ 7.) After a detailed review of other MTBE taste and odor studies, Dr. Lawless concluded that the Stocking study is the "most trustworthy," because:

> a) it is the only study to use a reasonably large and diverse consumer group as the population sample, b) it uses a well-known threshold method based on industry consensus (ASTM E-679), c) the actual data set is presented in several publications and is available for scrutiny and further analysis, d) the study was subcontracted to an independent testing laboratory with extensive experience in consumer testing and human sensory measurement, e) complete details of the procedure are available in the report by the Malcolm Pirnie group and the report's appendices, and f) test concentrations were confirmed by chemical analysis.

(Exp. Rept. (Defs' Ex. B) ¶ 18)[4] Dr. Lawless' conclusions are echoed in EPA's own peer-reviewed analysis of the Stocking data.[5] After reviewing "[a]t least eight prior studies … all [of which] have important drawbacks," EPA based its analysis solely on the

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[3] Stocking, A.J., Suffet, I, McGuire, M., Kavanaugh, M., *Implications of an MTBE Odor Study in Setting Drinking Water Stds.*, 93 J. Am. Water Works Ass'n 95, 2001 (Lawless Decl. Ex. 1).

[4] Dr. Lawless explains the shortcomings of each of the other MTBE taste and odor studies he reviewed in his Expert Report (Defs' Ex. B) at ¶¶ 19-29.

[5] *Statistical Analysis of MTBE Odor Detection Thresholds in Drinking Water*, EPA Report No. 815-R-01-024, August 2001 ("EPA 2001") (Schulman Decl. Ex. 2).

Stocking Study because "the data in Stocking et al. … provide the best available information about MTBE odor detection in drinking water." (*Id*. at 8.) Dr. "Mel" Suffet, a Stocking co-author and Defendants' expert in this case, also agrees that the Stocking Study is "the most valuable and reliable study of MTBE odor in drinking water." (Suffet Dep. I (Declaration of Todd Robins ("Robins Decl.") Ex. 1) at 152:21-24.).

Given the Court's familiarity with the details of the both protocol and results of the Stocking Study, *see Cain Opinion*, 593 F.Supp.2d at 557-58, the City will not repeat them here, except to highlight the following three points about the Study. First, the group threshold of 15 ppb reported in Stocking et al. (2001), which was derived pursuant to ASTM E679 by calculating the geometric mean of the panelists' individual thresholds, represents the concentration at which approximately 50% of the population can detect MTBE in water.[6] Second, 25 of the 57 consumer panelists (44%) correctly picked the sample containing MTBE at 2 ppb – the lowest concentration presented; ten (18%) chose correctly at 2 ppb ***and*** every higher concentration thereafter, and thus were determined to have individual detection thresholds of 1.4 ppb under the ASTM protocol.[7]

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[6] Stocking et al. (2001) (Lawless Decl. Ex. 1) at 103 ("the test panel geometric mean threshold [of 15 pbb] represents the threshold of approximately 50% of the consumers"); ASTM E-679-91 (Lawless Decl. Ex. 7) at 1 ("threshold determined by this practice" is "a best estimate" of "the stimulus level detectable with a probability of 0.5 by 50% of the population").

[7] In the *Cain Opinion*, the Court noted that 18% of the panelists "correctly picked the sample that had MTBE at 2 µg/L," but stated that "[w]hether all of these individuals 'detected' MTBE at 2 ppb is unclear given that … some of the participants may have guessed.…" *Cain Opinion*, 593 F.Supp.2d at 558, n.62. However, while it certainly possible that the 15 panelists who chose correctly at 2 ppb and then chose incorrectly at higher concentrations were guessing when they picked the sample with 2 ppb MTBE, it highly likely that the ten panelists who picked correctly at 2 ppb ***and*** every concentration thereafter actually chose correctly. (Rebuttal Rept. (Defs' Ex. E) at 4 ("the chances of getting all eight trials correct by guessing is less than one in 1,000").) ASTM E679 supports this view: correction for guessing is implicitly factored into its method for deriving individual detection thresholds, as correct picks at the lowest concentration are only

Third, these results indicate that the concentration scale (2-100 ppb) used in the Stocking odor test was *not* set to "begin well below the level at which the most sensitive panelist is able to detect" MTBE, as required by ASTM E679 (*id*. ¶ 6.1), thus creating a "floor effect." (Exp. Rept. (Defs' Ex. B) ¶ 16.) In other words, had Stocking et al. presented the consumer panel with sub-2 ppb concentrations – something Stocking co-author and defense expert Dr. Suffet says he would do if he "had the study to do over again"[8] – the overall odor detection threshold would likely have been lower. (Exp. Rept (Defs' Ex. B) ¶ 16; *see also* ASTM E679-91 (Lawless Decl. Ex. 7) at 1 ("the bias of the [threshold] estimate depends on the concentration scale steps chosen").)

Nonetheless, for his opinions in this case, Dr. Lawless accepted both the test protocol and the resulting dataset from the Stocking Study – *i.e.*, the matrix of correct and incorrect responses of the 57 panelists – as given. (Lawless Decl. ¶ 8.) However, rather than calculating an overall "threshold" value that represents the concentration at which half the population can detect MTBE, Dr. Lawless' objective was to find out what the data could tell us about the levels at which other significant, but smaller percentages of the population can detect MTBE. (*Id*.)

To answer that question, Dr. Lawless analyzed the raw Stocking data using a statistical approach that he describes in his Expert Report as "interpolation on a dose-response curve for percent correct as a function of concentration" (Exp. Rept. (Defs' Ex. B) n. 5), but which may be referred to in simpler terms as the "chance-corrected percentile method." (Lawless Decl. ¶ 9.) Dr. Lawless applied the chance corrected percentile method as follows:

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considered if all subsequent picks at higher concentrations are also correct. (ASTM E679-91 (Lawless Decl. Ex. 7) ¶¶ 8.3-8.4.)

[8] Suffet Dep. I (Robins Decl. Ex. 1) at 192:22-194:3.

1. Using the test results from the Stocking Study (*see* Stocking (2001) (Lawless Decl. Ex. 1) Fig. 1), he added the number of correct choices (x's) down each column to get a sum for each concentration level, and then divided by the number of panelists and multiplied by 100 to convert to a percent correct at each concentration.

2. He then fit a line to the data using two alternative statistical tools:

    a. A linear best fit (least squares) line, with the form y = bx+ a, where y is the percent correct, x is the log of the concentration, b is the slope and a is the intercept; and

    b. A logistic regression equation, log[P/(1-P)] = a+b*log(C), where P is the percent correct, C is the concentration of MTBE, a is the intercept and b is the slope.

3. Once the equation under each of the above alternatives was derived, using the standard Abbot's formula, where the corrected percentile = (observed percentile – chance probability)/(1 – chance probability), he corrected for guessing at the 66.6% correct, 50% correct and 40% correct concentration levels to get the true detection levels at 50%, 25% and 10%, respectively.

4. Finally, he converted the log concentration values to ppb.

(Lawless Decl. ¶ 9; Exp. Rept. (Defs' Ex. B) n.4-6.) Dr. Lawless found that the linear best fit (least squares) and logistic regression approaches yielded very similar values, but ultimately relied on the linear best fit values for his opinions, based on an R-squared analysis which showed that it produced a slightly better fit to the data (.93 v. .90). (Lawless Decl. ¶ 10.) Dr. Lawless also calculated 95% confidence intervals around his 10% detection value (0.5 to 4 ppb), 25% detection value (1.1 to 9.6 ppb) and 50% detection value (5 to 43 ppb). (*Id.*) These confidence intervals indicate a relatively narrow margin of error, especially at the lower percentiles. (*Id.*)

ARGUMENT

I. DR. LAWLESS' METHODOLOGY IS RELIABLE

A. Legal Context

Defendants' challenge to the reliability of Dr. Lawless' testimony is predicated on two related, and completely unsupported, assertions: (1) because the Stocking Study was conducted

in accordance with ASTM E679, the data from that Study must "be analyzed in terms of geometric mean only, not by some other methodology," no matter how sound that methodology may be; and (2) Dr. Lawless' chance-correct percentile method of analysis is "unprecedented." (Ds' Mem. at 17.) Defendants are wrong on both counts.

Under Rule 702, expert testimony is admissible "if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case." Fed. R. Evid. 702. There is no dispute as to factor (1): all parties agree that the Stocking Study data on which Dr. Lawless based his analysis is not just sufficient, but the most "valuable and reliable" data available regarding MTBE odor in drinking water. (*See* Suffet Dep. I (Robins Decl. Ex. 1) at 152:21-24.) Part B of Defendants' motion is targeted solely at factors (2) and (3) – *i.e.*, the reliability Dr. Lawless' method and its application in this case.

In the parlance of *Daubert's* four "reliability" factors,[9] Defendants' contentions appear focused exclusively on factors (2) (peer review) and (4) (general acceptance). Defendants do not – cannot – dispute that Dr. Lawless' "chance-corrected percentile" analysis of the Stocking data "can be and has been tested," as it is, by definition, "objectively verifiable." *See* Fed. R. Evid. 702, 2000 Adv. Committee Note. Likewise, Defendants raise no issues related to error rate, as Dr. Lawless includes confidence intervals for each of his quantitative conclusions. (*See* Exp. Rept. (Defs' Ex. B) ¶ 17, n.7.)

[9] In *Daubert*, the Supreme Court articulated "four, non-exclusive factors that bear on whether a technique has been derived by the scientific method." Cain Opinion at 11. Those factors "remain relevant to the determination of the reliability of expert testimony under" Rule 702. Fed. R. Evid. 702, 2000 Adv. Committee Note. The four *Daubert* factors are: (1) whether the method can be and has been tested; (2) whether the method has been subjected to peer review or publication; (3) any known error rate; (4) general acceptance in the relevant expert community. Cain Opinion at 11-12 (citing *Daubert v. Merrell Dow*, 509 U.S. 579, 592-594 (1993)).

B. ASTM E679 Does Not Preclude Alternative Statistical Analyses

Defendants' argument that Dr. Lawless' statistical analysis is unreliable simply because ASTM E679 does not expressly prescribe it fails for at least two reasons. First, nothing in ASTM E679 prohibits or invalidates alternative statistical analyses of data collected pursuant to the test procedure it describes. The practice defines the "panel threshold" as "the geometric mean of the best-estimate thresholds of the individual panelists," but says nothing one way or the other about how to estimate the concentrations at which specified portions of the population (other than 50%) can detect a contaminant. (*See* ASTM E679-91 (Lawless Decl. Ex 7) ¶ 8.) As Dr. Schulman explains, based on more than a decade of experience at EPA as an environmental statistician and his own alternative analysis of the Stocking data, in particular (*see* § C.4, *infra*):

> Basic statistical theory contradicts [Defendants'] argument. Statistical analysis is built on probability models, which depend on assumptions about the way in which the data are collected, but have nothing at all to say about the experimenter's intent or state of mind. Therefore, the validity of a statistical analysis does not depend on whether the experimenter foresaw it at the time of the experiment. Rather, it depends on whether the data satisfy the assumptions of the analysis. In short, we are not forever doomed to use only the ASTM E-679 analysis, just because the Stocking study was designed with that analysis in mind….
>
> ASTM E-679 defines only one possible odor detection threshold (the level at which half of consumers can detect a contaminant half of the time), not the only one for all purposes. There is an infinite number of such possible thresholds, and no one of them can be expected to be right for all purposes. Different thresholds can, for example, be used to initiate regulatory action than are used to set treatment levels. The description of ASTM E-679 never says otherwise, and in fact it never states any purpose for which it must or must not be used.

(Schulman Decl. ¶¶ 8-9.)

In addition to EPA, the California Department of Health Services (DHS) also squarely rejected the argument that the geometric mean calculation prescribed by ASTM E679 is the only scientifically justifiable use of the Stocking data. As DHS stated in its response to public comments criticizing it for adopting a MTBE secondary maximum contaminant level lower than

the group geometric mean threshold calculated by Stocking et al., "*the commentator has not demonstrated why a geometric mean is more scientifically justifiable than the lowest level detected*." (Robins Decl. Ex. 2 at 9) (emphasis added). Both EPA and DHS have found Defendants' "ASTM way or the highway" argument unpersuasive; this Court should too.[10]

Second, Defendants ignore the fact that the Stocking Study involved a significantly larger test panel than ASTM E679 was intended for. The larger, more robust data set it produced is more amenable to the type of probability analysis Dr. Lawless conducted. ASTM E679 "describes a rapid test for determining sensory thresholds" from "limited-size data sets of 50 to 100 3-AFC presentations." (ASTM E679-91 ¶ 1.1; ASTM E1432-04 at 1 (Lawless Decl. Exs. 7-8).) In other words, ASTM E679 was designed for tests involving small panels of less than ten subjects, not a population study. (Lawless Decl. ¶ 37.) Because of the statistical limitations inherent in working with very small data sets – in particular, "the very large degree of random error associated with estimating the probability of detection from only 50 to 100 3-AFC presentations" (ASTM E679-91 (Lawless Decl. Ex. 7) at 1) – ASTM E679 prescribes a simple geometric mean method of approximating group thresholds. (Lawless Decl. ¶ 36.)[11] The Stocking Study, on the other hand, involved *456* 3-AFC presentations (eight presentations to 57 panelists). With its larger panel and resulting data set, the Stocking Study presents far less uncertainty in terms of deriving percent-correct values along a dose-response curve than would

[10] *See, e.g., 350 W.A. LLC v. Chubb Group of Ins.*, 2007 WL 4365502, *22-*23 (S.D.Cal. 2007) (Under *Daubert*, where "established [ASTM] tests did not generate desired information," expert witness was permitted "latitude in applying ASTM procedures in accordance with the scientific method"); cf. *Ruffin v. Shaw Industries, Inc.*, 149 F.3d 294, 300 (4th Cir. 1998) (expert testimony unreliable when based on modifications to ASTM testing protocol that are directly "contrary to the ASTM procedural guidelines").

[11] *See also* EPA (2001) (Schulman Decl. Ex. 2) at 17 ("ASTM method E679-91 uses a simpler individual threshold estimator, intended for smaller experiments where the dose-response relationship is harder to estimate").

the typical ASTM E679 data set. (*Id*. ¶ 37.) As such, Dr. Lawless had ample justification for departing from the strict confines of ASTM E679 in performing his analysis of the Stocking data.

C. Dr. Lawless' Methodology Has Ample Precedent

Other than the ASTM standard practice's silence as to Dr. Lawless' methodology, which proves nothing, Defendants are left with nothing but their bald – and patently false – assertion that the statistical analysis Dr. Lawless employed is "unprecedented." (Defs' Mem. at 17.) As demonstrated below, Defendants' assertion is absolutely wrong in every conceivable respect.[12]

1. The statistical equations Dr. Lawless used are well-established for the data interpretation purposes to which he put them

As a threshold matter (no pun intended), there is nothing novel about any of the three statistical equations Dr. Lawless used to analyze the Stocking data. Abbot's formula, the equation he employed to correct for guessing, has been a standard formula to adjust for baseline response since the 1920s, and has been cited extensively in the peer-reviewed literature related to sensory evaluation methods as an appropriate method to correct for guessing, including in Dr. Lawless' own textbook and a published, peer-reviewed study he co-authored. (Lawless Decl. ¶¶ 22-24, Exs. 2-3.) As Dr. Lawless and his co-authors stated in the study, "[i]n order to correct for chance performance, Abbot's formula has been widely used in psychology for decades."[13]

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[12] Defendants' sole support for their argument that Dr. Lawless' method is "unprecedented" is an alleged "admission" by Dr. Lawless that is nothing but a distortion of his deposition testimony. Defendants claim Dr. Lawless "admits that he cannot identify anyone in reported literature or research who has suggested that it is permissible to modify the ASTM standard to employ a method other than the geometric mean." (Defs' Mem. at 17-18.) But all Dr. Lawless "admitted" was that he was unaware of any proposals to modify the ASTM E679 standard practice itself – *not* that he was unaware of anyone in reported literature or research using methodologies similar to his. (Lawless Dep. (Defs' Ex. A) 173:24-175:6.) As shown below, examples of others' and Dr. Lawless' own prior use of the methods he employs in this case abound.

[13] Antinone, M. A., Lawless, H., Ledford, R., Johnston, M., 1994, *The importance of diacetyl as a flavor component in full fat cottage cheese*, 59 Jl. of Food Science 38, 39 (Lawless Decl. Ex. 2)

Abbot's formula is also specifically prescribed as the method for converting "results to percent correct above chance" in ASTM E1432, a standard practice similar to E679 but designed for larger data sets. (ASTM E1432-04 (Lawless Decl. Ex. 8) at ¶ 8.1.2, p.1.)

Likewise, the techniques of linear and logistic regression analysis are generally accepted methods of doing just what Dr. Lawless did: fitting a linear mathematical model to measurements obtained from an experiment. (Lawless Decl. ¶ 26.) They are commonly used in threshold methods. (*Id*. ¶ 27.) In short, both techniques "are basic statistical workhorses, widely used and well understood, and applicable to the Stocking data." (Schulman Decl. ¶ 10.)

2. Dr. Lawless has taught the chance-corrected percentile analysis for ten years, written about it in his textbook and used it in a peer-reviewed sensory threshold study

Nor is there anything unprecedented about use of these statistical techniques either in the manner or context in which Dr. Lawless has used them in this case. In fact, Dr. Lawless has taught the very same chance-corrected percentile method he used in this case every year for the past decade in his primary course at Cornell "as an alternative to the ASTM procedure of calculating the geometric mean … in a laboratory exercise that uses the [forced-choice testing] methods of ASTM E-679." (Exp. Rept. (Defs' Ex. B) n. 5) He has also included a specific discussion of the method in the most recent revisions to his textbook, using the Stocking MTBE data and his analysis in this lawsuit as a case study. (Lawless Decl. Ex. 4.) The revisions have been read and approved by Dr. Lawless' co-author, Dr. Hildegarde Heymann, an environmental chemist and sensory scientist at the University of California, Davis, who raised no objections to his analysis of the MTBE data using the chance-corrected percentile method. (*Id*. ¶ 25.) In his expert report, Dr. Lawless also cites a peer-reviewed, published study he co-authored where he employed the chance-corrected percentile statistical method he used here in the context of a

three-alternative-forced-choice threshold detection experiment similar to the Stocking odor test. (Exp. Rept. (Defs' Ex. B) n. 5, citing Antinone et al. (1994) (Lawless Decl. Ex. 2) at 39.)

Considering that Dr. Lawless had neither worked on an MTBE case before nor reviewed any MTBE taste and odor data prior to his retention in this case late last year (Lawless Decl. ¶ 3), the foregoing facts demonstrate not only that his methods have "precedent," but also that his approach is one that "grow[s] naturally and directly out of research [he has] conducted independent of the litigation," and is not one he developed "expressly for purposes of testifying." *See Daubert v. Merrell Dow Pharms., Inc.*, 43 F.3d 1311, 1317 (9th Cir.1995). Accordingly, Defendants' attempt to suggest that Dr. Lawless' opinions were "manufactured" to "amplify" the City's damages claims is nonsense. (*See* Defs' Mem. at 3, 16; *see also* Lawless Decl. ¶¶ 32.)[14]

3. The Campden 2003 MTBE odor study utilized the linear least squares method to match population percentile to MTBE concentration along the dose-response curve, just as Dr. Lawless did

Even within the limited realm of MTBE odor threshold studies, Dr. Lawless' linear best fit (least squares) technique has precedent. For example, in the MTBE odor study known as Campden (2003), the authors used the very same linear least squares method Dr. Lawless used. (Lawless Decl. Ex. 5.) Specifically, after conducting a three-forced-choice MTBE odor test on 55 consumer panelists, the Campden authors used "a lognormal curve fit to the data" – that is, they derived a linear best fit (least squares) line – "to determine the percentage of consumers" who can detect MTBE at a certain concentration. (*Id*. at Appendix 2 (NYC-LAWLESS-1043).)

Defendants' own expert, Dr. Suffet, who was an "observer" on the Campden 2003 study, agreed that this straightforward linear fit to the data would enable an analyst to estimate the

[14] *See also* Suffet Dep. II (Robins Decl. Ex. 1) at 387:13-17 ("Q. What evidence do you have that Harry Lawless entered into his work on this case with a pre-formed conclusion? A. I don't have any -- any evidence that he did….")

concentration at which a given percentage of consumers can detect MTBE and vice versa:

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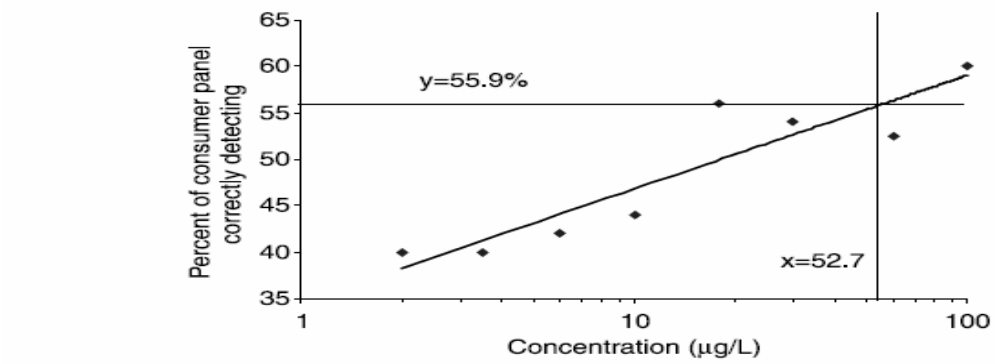
Q. And that best fit analysis allows you to look at any point on that line and look down and see the corresponding concentration, and look across and see the corresponding percent of the consumer panel correctly detecting, correct?
MR. MOLLER: Objection. Lacks foundation.
THE WITNESS: **If -- if -- yes, that's -- that's what it's showing.**
BY MR. ROBINS:
Q. And do you view that to be a scientifically unreliable or inappropriate statistical analysis with odor threshold data?
MR. MOLLER: Objection. Vague.
THE WITNESS: **They're just doing the same thing that I -- that was done in Figure 1. They are just plotting the data. And they -- they drew a line. That's fine**.

(Suffet Dep. I (Robins Decl. Ex. 1) at 290:8-24.) Although the Campden authors apparently limited their analysis to determining the percentage of consumers who could detect MTBE at 52.7 µg/L, the panel geometric mean threshold they had calculated (*see* Figure 1), there is no scientific reason a best-fit line could not be used to determine other corresponding percentages and concentrations along the dose-response curve, as Dr. Lawless did here. (Lawless Decl. ¶ 28.)

Figure 1[15]



[15] Figure 1 is a version of the graph in Appendix 2 of Campden (2003) (Lawless Decl. Ex. 5) as it appeared in a subsequent article authored by defense expert Mel Suffet (*id*. Ex. 6 at 269).

4. Both Stocking et al. and EPA conducted their own, chance-corrected percentile analyses of the Stocking test data using methods similar to Dr. Lawless', and obtained very similar results

Even more to the point, at least two other studies – an unpublished 2000 report by Stocking et al. and a peer-reviewed, official EPA report from 2001 – analyzed the same 1998 Stocking odor test data using alternative statistical methods quite similar to Dr. Lawless' chance-corrected percentile method for precisely that same purpose: to estimate the concentrations at which portions of the population less than 50% can detect MTBE. Both those studies concluded that 10% of the population can detect MTBE in drinking water at approximately 2 ppb – results that are remarkably consistent with Dr. Lawless' opinion in this case. These studies definitively disprove the thesis of Defendants' motion, and should eliminate any remaining doubt that statistical analyses of the Stocking test data other than the group geometric mean threshold may legitimately be performed in order to determine the concentrations at which more sensitive segments of the population can detect MTBE.

The unpublished 2000 report by the Stocking Study authors ("Stocking et al. (2000)") [16] is as ironic as it is devastating to Defendants' motion. The report, which lists Defendants' own expert, Mel Suffet, as the second author, states that "one of the initial objectives" of the Stocking Study was, in fact, to do exactly what Defendants attack Dr. Lawless for doing here: that is, "*perform a more rigorous statistical analysis of the results from the threshold odor test to understand the percentage of the population who might be able to detect MTBE at various levels*." (Stocking et al. (2000) (Schulman Decl. Ex. 3) at 13 (emphasis added).) That "more rigorous statistical analysis" consisted of a two-step chance-corrected percentile analysis very

[16] The unpublished version of the Stocking Study discussed herein (Schulman Decl. Ex.3) lists the same authors and bears the same title as the published article, Stocking et al. (2001), that appeared in the Journal of the American Water Works Association in March 2001 (*see* Lawless Decl. Ex. 1), but has a "submitted" date of June 12, 2000.

similar to the method Dr. Lawless used here.

First, "[a] logistic regression analysis of the data – a technique commonly used for bioassays – was used to estimate the concentration of MTBE at which a given fraction of the testing subjects would respond in a particular way." (*Id*. at 14.) This is *precisely* what Dr. Lawless did. Next, after observing that their "statistical analysis cannot be directly applied to consumer drinking water taste and/or odor studies due to the ASTM E679-91 experimental design, which dictates that random guessing produces a correct identification about a third of the time, even if the consumer cannot sense an odor," Stocking et al. (2000) applied a "guessing correction factor" to the analysis. (*Id*.) Although Stocking et al. (2000) used a different statistical method to correct for guessing, their reasoning for performing a chance-correction analysis is identical to Dr. Lawless'. And their results – 5% detection at 1.5 ppb, 10% detection at 2.2 ppb, 25% detection at 6.2 ppb – unquestionably corroborate his. (*Id*. at 32; *see also* EPA (2001) (Schulman Decl. Ex. 2) at 9.)[17] Although the report is unpublished, the Stocking et al. (2000) analysis of the same data set Dr. Lawless analyzed, using virtually the same chance-corrected percentile analysis he used, alone provides sufficient grounds to deny Defendants' motion. *See Srail v. Village of Lisle*, 249 F.R.D. 544, 562 (N.D. Ill. 2008) (plaintiff's expert's methodology reliable even though it had not been peer reviewed because defendant's expert had used the same test results as plaintiff's to draw his own conclusions).

In 2000-2001, EPA conducted its own statistical analysis of the Stocking data as presented in Stocking et al. (2000), entitled *Statistical Analysis of MTBE Odor Detection*

[17] EPA subsequently criticized the correction for guessing technique employed by Stocking et al. (2000) – not because correction for guessing is invalid, but because the specific formula they used contained an error. (EPA (2001) (Schulman Decl. Ex. 2) at 23.) As EPA noted, the error in the Stocking et al. (2000) chance-correction method only manifests itself at the higher percentiles and concentrations (*id*.), hence the fairly close agreement between Stocking et al. (2000) and Dr. Lawless' estimate for the concentration at which 10% of the population can detect MTBE.

Thresholds in Drinking Water. (Schulman Decl. Ex. 2.) Prior to the agency's August 2001 publication of the report, EPA submitted its analysis to a committee of four peer-reviewers – a sensory methods expert, a water industry expert and two expert statisticians. (Schulman Decl. ¶ 5.) EPA's objective, like Dr. Lawless', was to estimate "at what concentration any given fraction of the population can detect MTBE at least half of the time." (Schulman Decl. ¶ 3; EPA (2001) (Schulman Decl. Ex. 2) at 26.)

Using the Stocking test results, EPA (2001) computed an ASTM threshold estimate for each test subject (which implicitly accounts for guessing), fit a dose-response model to the data using a complex logistic regression analysis, and then obtained the concentrations at various population percentiles from the fitted data. (EPA (2001) (Schulman Decl. Ex. 2) at 26-27, 30.) The EPA (2001) statistical analysis of the Stocking data also yielded results extremely similar to Lawless' – 10% of the population detecting at 2.2 ppb; 25% detecting at 5.5 ppb. (*Id*., at 9.)

The peer-reviewed EPA (2001) report thus further confirms that, when it comes to the Stocking data, it is *not* the ASTM E679 way or the highway, as Defendants contend. Scientifically valid analyses of the data set other than the simple geometric mean calculation, including logistic regression to estimate the concentrations at which smaller percentiles of the population can detect MTBE can be, and have been, done. In Dr. Schulman's own words:

> Statistical methods other than those prescribed by ASTM method E-679 may legitimately be used to analyze the data from the Stocking study, and the particular methods employed by Dr. Lawless in the Expert Report are appropriate and scientifically valid.

(Schulman Decl. ¶ 7.)

One additional point: not only does EPA (2001) corroborate Lawless' primary opinions in this case regarding the levels at which 10% and 25% of the population can detect MTBE, but Lawless *and* EPA are also both corroborated by the ASTM E679 geometric mean calculation as

applied to the Stocking data. Using similar alternatives to the ASTM statistical methodology, Lawless and EPA both found that 50% of the population can detect MTBE at 14-15 ppb. This is essentially the same value the Stocking authors obtained using the ASTM geometric mean method in Stocking et al. (2001): 15 ppb. Thus, Lawless' results are corroborated not only by Stocking et al. (2000) and EPA (2001), but also by the one method Defendants themselves hold up as legitimate: ASTM E679. These multiple points of cross-corroboration unquestionably underscore the reliability of Dr. Lawless' approach in this case.[18] For the Court's reference, a chart comparing the methodologies and results of Stocking et al. (2000), EPA (2001), Dr. Lawless' work in this case and Stocking et al. (2001) is attached hereto as Appendix A.[19]

II. DR. LAWLESS' OPINIONS ARE RELEVANT AND WILL ASSIST THE JURY

Under Rule 702, expert testimony is admissible if, among other things, it "will assist the trier of fact to understand the evidence or to determine a fact in issue." Fed. R. Evid. 702. "This condition goes primarily to relevance." *Daubert*, *supra*, 509 U.S. at 591. "The Rule is broadly phrased," so "[w]hen opinions are excluded, it is because they are unhelpful and therefore superfluous and a waste of time." Fed. R. Evid. 702, 1972 Adv. Committee Note. Under this standard, Defendants' relevance argument does not even leave the starting gate.

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[18] *See Sun Microsystems Inc. v. Hynix Semiconductor Inc.*, --- F.Supp.2d ----, 2009 WL 909766, *43 (N.D. Cal. 2009) (because "additional analyses tend to corroborate Dr. White's initial testimony, they support a finding of reliability"); *ID Sec. Systems Canada, Inc. v. Checkpoint System, Inc.*, 2002 WL 1042340, *4 (E.D. Pa. 2002) (finding expert's opinion reliable in part because it was "corroborated … by a well qualified expert").

[19] To the extent Defendants contend that the foregoing arguments rely improperly on materials Dr. Lawless produced after his deposition, they are misguided. *See* Fed. R. Civ. P. 26(e)(2); *see also* Apr. 16, 2009, email from L. Handel to S. Ard. Dr. Lawless has not modified his opinions in any respect; he has properly gathered additional materials in support of his opinions in response to Defendants' criticisms.

A. This Court's Prior Holding That "The Jury Must Consider The Variation In The Population's Ability To *Detect* MTBE When Determining The Extent" Of a Plaintiff's Injuries Is Fatal To Defendants' Argument

Despite the inspiration they have drawn from the *Cain Opinion* (*see* Defs' Mem. at 4), Defendants overlook the key aspect of the *Cain Opinion* that is fatal to their relevance argument. In the *Cain Opinion*, the Court provided a crystal clear statement of the factual and legal context into which the expert debate regarding MTBE's taste and odor characteristics must fit:

> The jury must consider the variation in the population's ability to *detect* MTBE when determining the extent to which plaintiffs have been harmed. For example, it is conceivable that a jury would conclude that a reasonable company would not take steps to remove MTBE from the water if only 0.1%, 1%, 10%, or even 25% of the population found it unpleasant to drink depending on the particular circumstances of the case.
>
> In the end, the issue of when the water suppliers are harmed by MTBE contamination is fact-specific in a variety of ways not discussed here. Nonetheless, the fact that there is a wide variation within the population of the ability to *detect* the chemical must be considered by the jury when it determines whether plaintiffs were harmed.

593 F.Supp.2d at 552-53 (emphasis added). Accordingly, the Court held, there is "no doubt that 'scientific, technical or other specialized knowledge will assist the trier of fact….'" *Id*. at 556.

That holding and its underlying rationale apply with equal force in this case. Dr. Lawless' expert testimony regarding the concentrations at which various percentages of the population can detect MTBE in water is *exactly* the kind of "scientific, technical or other specialized knowledge that will assist" the jury when it "consider[s] the variation in the population's ability to detect MTBE." The Court's criticism of Dr. Cain for his failure to provide any consistent position "regarding the percentage of the population that can detect MTBE" at 1 ppb supports that view. *Id*. at 559-60. In short, the testimony Dr. Lawless proposes to give goes to the very heart of the issue this Court has held the jury "must consider" when it determines the extent of the City's taste-and-odor-related injuries.

B. The City's Injury Claims Based On MTBE's Taste And Odor Do Not and Need Not Depend Upon Past Customer Complaints

Defendants' attempt to exclude Dr. Lawless' testimony on relevance grounds misconstrues the nature of the City's taste-and-odor related claims. Defendants assert, without support, that "Plaintiff claims it has suffered injury because its customers have lodged and will continue to lodge taste and odor complaints about their drinking water attributable to MTBE." (Defs' Mem. at 9.) That is not what the City claims. Nowhere in its complaint, other pleadings or discovery responses has the City predicated its claimed injuries on past taste and odor complaints attributable to MTBE. As Defendants well know, the Station 6 "focus wells" the City selected for trial have *never been used* as drinking water production wells since the early 1980s. (*In re MTBE*, No. 1:00-CV-1898, Dkt. # 2202 (S.D.N.Y. Filed Nov. 5, 2008) at 38). As to other wells, the City reserved its rights on the issue of complaints, but has been clear that "our case is not built on arguing that we have 1,500 complaints or any X number of complaints … that are about MTBE." (*Id*. at 41.) The City has no intention of pursuing any claims based on past customer complaints, as it "cannot be determined" from the City's complaints data "whether past taste and odor complaints are attributable to the presence of MTBE." (Schindler Decl. ¶ 14.)

Defendants' also wrongly assume that, as a matter of law, the City may only prove up its injury claims based on MTBE's taste and odor by means of past customer complaints attributable to MTBE. Defendants' overly narrow formulation, for which they offer no legal support, cannot be reconciled with the Court's statements in the *Cain Opinion* that "the jury must consider the variation in the population's ability to *detect* MTBE when determining the extent to which plaintiffs have been harmed," and that such determination will "depend[] on the particular circumstances of the case." 593 F.Supp.2d at 552. Nor can Defendant's position be reconciled with any other prior holding of this Court. In the Court's October 10, 2006, Opinion and Order

denying Defendants' Motion for Summary Judgment for Lack of Justiciability, which was rendered on an incomplete factual record long before expert discovery, the Court admonished that "speculation" regarding the linkage between customer complaints and MTBE contamination would be "insufficient to defeat summary judgment." *In re MTBE*, 458 F.Supp.2d 149, 159 (S.D.N.Y. 2006). But the Court did *not* hold, as Defendants suggest, that customer complaints linked to MTBE are the *only* viable means of proving injuries related to taste and odor. *Id*.

C. Defendants Have No Competent Evidence To Support Their Allegation That MTBE's Detection Threshold Is Lower Than Its Rejection Threshold

Defendants' relevance argument also fails because its primary factual premise – that the level at which water consumers can detect MTBE in water "is almost always lower" than the level at which they will object to, or complain about, its presence – has no evidentiary support. (*See* Defs' Mem. at 3, 13.) As Defendants' expert Dr. Suffet plainly acknowledged at deposition, no studies have ever been done to determine a rejection threshold for MTBE:

431

Q. What studies, if any, are you aware of that actually attempt to determine a rejection threshold for MTBE?

432

A. **No studies have been designed to determine rejection threshold**.

(Suffet Dep. II (Robins Decl. Ex. 1) at 431:22-432:2; *see also* EPA (2001) (Schulman Decl. Ex. 2) at 12 ("existing studies of MTBE consider mostly detection, with a small amount of data on recognition and none on rejection").)[20] Defendants, consequently, are forced to rely on a study relating to an entirely different substance – trichloroanisole, an off-flavorant in white wine –

[20] Dr. Lawless' academic interest in conducting an MTBE rejection threshold study is of no moment. (*See* Defs' Mem. at 2, 11-12.) His discussion with counsel on the topic "did not in any way influence or bear upon my testimony regarding the detectability of MTBE." (Lawless Dep. (Defs' Ex. A) at 94:5-12.) Defendants' own expert agrees that a consumer rejection study is unnecessary in this case. (Suffet Dep. II (Robins Decl. Ex. 1) at 436:2-9.)

which has been shown to have a rejection threshold higher than its detection threshold. (Defs' Mem. at 14.) As much as Defendants would like to turn wine into water, "transferring the results from a study of one substance to another has no validity." *Cain Opinion*, 593 F.Supp.2d at 561. Thus, on the record Defendants have presented, the Court has no basis to accept their premise that any meaningful difference exists between detection and rejection when it comes to MTBE.

D. Defendants' Relevance Argument Is An Improper Attempt To Argue the Evidence On a Disputed Fact Issue

Even if one were to accept, *arguendo*, that MTBE's rejection threshold is higher than its detection threshold – and again, Defendants have submitted no competent evidence to indicate that it is – it would do nothing to reduce the ***relevance*** of Dr. Lawless' testimony to the City's claims. As the Court held in the *Cain Opinion*, the ultimate issue here is "when the water suppliers are harmed by MTBE contamination," which is a "fact-specific" inquiry that "depend[s] on the particular circumstances of the case." 593 F.Supp.2d at 552. In this case, it is the City's position that evidence showing 10% of residents in the City's groundwater service area will be able to smell MTBE in their water at 1-2 ppb (as per Dr. Lawless), in combination with other factors such as MTBE's potential to cause cancer and the City's overriding policy of ensuring that the water it provides from its groundwater system is as pure and clean as the water its provides from the surface supply system, is sufficient to prove that low levels of MTBE "harm" the City's water supply. (*See* Schindler Decl. ¶¶ 10-19.)[21] Defendants may disagree, but as they concede in their motion, expert testimony "fits" the facts of the case for purposes of Rule 702 so long as it has "'a valid scientific connection' to a ***disputed*** fact in the case." (Defs' Mem.

[21] *See also* Cain Opinion, 593 F.Supp.2d at 552, n.14 ("Plaintiffs could be harmed in other ways," including "if MTBE were found to cause cancer, or even suspected of causing cancer").

at 6, quoting *Daubert*, 509 U.S. at 592)) (emphasis added). Defendants' "fit" argument is thus a misplaced attempt to argue the evidence on a disputed fact issue the jury must decide.

E. There Is No Material Difference Between Detection and Rejection In the Context of Public Acceptance of Drinking Water in New York City

Finally, Defendants' attempt to drive a relevance wedge between detection and rejection fails because there is no practical, real-world difference between detection and rejection when it comes to the factors affecting public acceptance of water in New York City. As Steven Schindler, Director of Water Quality for the NYCDEP Bureau of Water Supply, explains:

- "Based on the Department's past experience, it is more likely than not that the public will object to any taste or odor attributable to the presence of a toxic chemical constituent, such as MTBE, even if it is assured that the concentrations of that chemical constituent are below harmful levels…. This is because residents typically find any indication that a contaminant is present in drinking water objectionable." (Schindler Decl. ¶¶ 8, 17.)

- Since 2007, the Queens groundwater system has been off-line, and those living in the groundwater service area have received the exceptionally high-quality drinking water delivered from the City's upstate reservoirs. Because those residents "are accustomed to receiving high quality water, it is unlikely that residents who receive groundwater in the future will simply accept a new taste or odor in their water supply, regardless of whether that taste or odor is, in itself, objectionable." (*Id.* ¶¶ 10, 16.)

- "It is the policy of NYCDEP that, to the extent feasible, water provided in the future from … the groundwater system for extended periods of time, be as pure and clean, in terms of toxic chemical contaminants, as the water from the surface supply system." (*Id.* ¶ 12.)

- "Station 6 alone will be capable of providing water to 70,000 residents when it is placed into operation. Based on Dr. Lawless' report, 10%, or 7,000 of those residents, would be able to detect a taste or odor attributable to MTBE at levels of 1-2 ppb. If even a fraction of those 7,000 residents were to lodge a complaint or inquiry, it would likely cause a strong public reaction and NYCDEP would likely be faced with vocal opposition from the community, particularly in light of the fact that the majority of the water users served by NYCDEP do not receive water with MTBE contamination.." (*Id.* ¶ 15.)

- "Accordingly, NYCDEP should not allow for the possibility that a significant portion of the population that will receive water from the groundwater system will be able to detect a taste or odor attributable to MTBE…. Based on Dr. Lawless' conclusions, NYCDEP must treat for MTBE to achieve concentrations below 1-2 ppb in order to ensure public acceptance of the long-term use of the groundwater supply." (*Id.* ¶¶ 18-19.)

The City's position is not without substantial precedent and support. In explaining the rationale for its adoption of a SMCL for MTBE, the California DHS similarly found that no real-world difference between detection and rejection exists when it comes to chemical contaminants like MTBE in drinking water:

> From the Department's experience, any indication in a drinking water that a contaminant is present is generally highly objectionable to the consumer, even if reassured that no health risk is posed. In addressing the effect of a contaminant on odor or taste the Department would not give deference to a pleasant tasting contaminant over a one that is less pleasant, nor to a level of a specific contaminant that is pleasant tasting over a level that is not. Furthermore, the public will find objectionable any odor and taste that it has learned to identify with MTBE or any other chemical.

(Robins Decl. Ex. 2 at 11); *see also Western States Petroleum Ass'n v. State Dept. of Health Services*, 99 Cal.App.4th 999, 1014 (2002) (DHS "was not required to find acceptable a contaminant that imparts a taste or odor to drinking water simply because the taste or odor is not described in terms of revulsion"). The DHS also found that protecting public welfare and ensuring public acceptability of drinking water requires protecting a greater proportion of the population than 50%:

> The Department believes that in setting a drinking water standard, it should strive to meet a higher goal for public welfare protection than only half the population. . . . The Department, as public health agency, must act to protect the greatest portion of the consumer population as is feasible.

(Robins Decl. Ex. 2 at 9, 14); *see also Western States Petroleum Ass'n*, 99 Cal.App.4th at 1011 (SMCL that protects more sensitive consumers protects "a substantial number of persons" because "a fairly small portion of a whole may be considered substantial").

Based on the foregoing, the City's undoubtedly has a reasonable basis for believing that low concentrations of MTBE detectable by a small, but significant portion of the consuming public will interfere with, and thus damage, its groundwater supply sufficient to overcome

Defendants' relevance challenge. The City's claimed injuries related to taste and odor, likewise, have an obvious – indeed inextricable – nexus to Dr. Lawless' testimony. "On the particular circumstances of this case," therefore, Dr. Lawless' testimony about the levels at which more sensitive portions of the population can detect MTBE will assist the jury in determining the extent of the City's MTBE-related injuries, and Defendants' motion must fail.

CONCLUSION

For the foregoing reasons, and those set forth in the accompanying Declarations of Steven C. Schindler, Andrew E. Schulman and Harry T. Lawless, the City respectfully requests that the Court DENY in its entirety Defendants' motion to exclude the opinions of Dr. Lawless.

Dated: San Francisco, California
May 14, 2009

MICHAEL A. CARDOZO
Corporation Counsel of the City of New York
Attorney for Plaintiff City of New York
100 Church Street
New York, New York 10007
(212) 788-1568

/s/ *TODD E. ROBINS*
VICTOR M. SHER *(pro hac vice)*
TODD E. ROBINS *(pro hac vice)*
JOSHUA G. STEIN (*pro hac vice)*
LESLEY E. WILLIAMS (LW8392)
NICHOLAS G. CAMPINS *(pro hac vice)*
MARNIE E. RIDDLE (*pro hac vice)*

SHER LEFF LLP
450 Mission Street, Suite 400
San Francisco, CA 94105
(415) 348-8300

Attorneys for Plaintiff City of New York

APPENDIX A

ALTERNATIVE STATISTICAL ANALYSES OF THE STOCKING DATA HAVE YIELDED SIMILAR RESULTS

FIGURE 1 Individual consumer results from the threshold odor study

x Correct identification
o Incorrect identification
Geometric mean of concentrations in shaded areas represents individual consumer threshold

Consumer	Concentration—μg/L							
	2	3.5	6	10	18	30	60	100
1	x	o	x	x	x	x	x	x
2	o	o	o	x	x	x	x	o
3	o	x	o	o	o	o	x	x
4	o	o	o	o	o	o	x	x
5	x	o	x	o	x	x	o	x
6	o	o	x	x	x	x	x	x
7	o	x	x	o	x	x	x	x
8	x	x	o	x	x	x	x	x
9	o	o	x	o	x	x	x	x
10	o	o	o	o	o	o	o	x
11	x	o	x	x	x	x	x	x
12	o	o	o	o	x	o	x	o
13	x	x	x	x	x	x	x	x
14	x	x	x	x	x	x	x	x
15	o	x	x	o	x	x	x	x
16	o	o	x	o	o	o	x	o
17	x	o	x	x	x	x	x	x
18	o	o	x	x	x	x	x	x
19	x	x	x	x	x	x	x	x
20	x	o	x	x	o	x	o	o
21	x	x	x	x	x	x	x	x
22	x	x	x	x	x	x	x	x
23	x	x	o	o	x	x	x	x
24	x	x	x	x	x	x	x	x
25	o	x	x	x	o	x	x	x
26	o	x	x	x	o	x	x	x
27	x	o	o	o	x	o	o	x
28	o	o	x	x	x	x	x	o
29	o	x	o	o	x	x	x	x

Consumer	Concentration—μg/L							
	2	3.5	6	10	18	30	60	100
30	o	x	x	o	x	x	x	x
31	x	o	o	x	o	o	x	o
32	x	x	x	x	o	o	o	x
33	x	x	x	o	x	o	x	x
34	o	o	o	o	o	o	x	o
35	o	o	o	x	o	x	x	o
36	o	o	o	x	o	x	x	x
37	x	x	x	x	x	x	x	x
38	x	o	x	x	x	x	x	x
39	x	x	o	o	x	x	x	x
40	o	o	x	o	x	x	x	x
41	x	x	x	x	x	x	x	x
42	o	x	o	x	x	x	x	x
43	o	o	o	o	o	o	x	x
44	o	x	x	o	x	o	x	x
45	o	x	x	o	x	x	x	x
46	x	x	x	x	x	o	x	x
47	o	x	o	o	o	x	x	o
48	o	x	o	x	o	x	x	x
49	o	o	o	x	o	x	x	x
50	o	o	x	x	x	x	x	x
51	o	o	o	x	x	x	x	x
52	x	x	x	x	x	x	x	x
53	x	x	x	x	x	x	x	x
54	x	o	o	o	o	x	x	x
55	o	o	x	x	x	x	x	x
56	o	o	o	o	o	x	x	x
57	o	o	x	x	o	x	o	x

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Alternative statistical analyses

Lawless Expert Report (2009)

Stocking et al. Draft Paper (2000)

Schulman et al. EPA Report (2001)

Stocking et al. (2001)

Logistic regression to estimate concentrations at which various percentages of the population can detect MTBE

Geometric Mean of Calculated Individual Thresholds = Odor Threshold Conc.

Abbot's Formula adjustment for guessing

33% correction for guessing

Probability of guessing accounted for in model fit

Guessing implicitly accounted for in calc. of individual thresholds

10% = 1-2 ppb
25% = 3 ppb
50% = 14 ppb

5% = 1.51 ppb
10% = 2.2 ppb
25% = 6.24 ppb
50% = 57 ppb

5% = 1.3 ppb
10% = 2.2 ppb
25% = 5.5 ppb
50% = 15 ppb

50% = 15 ppb